Fraunhofer USA, Inc
Center for Experimental Software Engineering Maryland

Making Use of a Decade of Widely Varying Historical Data

SARP project

"Full Life-cycle Defect Management"

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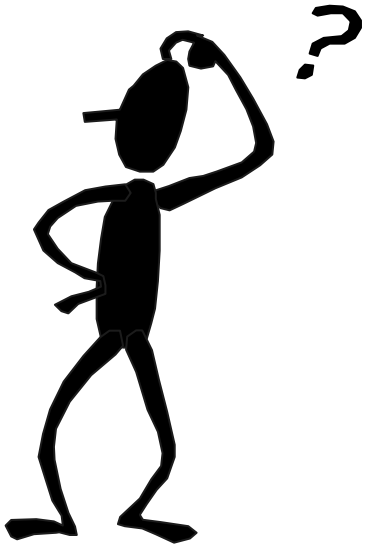
Problem we are addressing

- We are in the second year of our initiative and studying
  - Parameters that affect the results of inspection
  - The relation between V&V effectiveness in early lifecycle (e.g., inspection) and late (testing)

- We are using this information to provide feedback and decision support to NASA projects, on questions such as:
  - Can I get guidance on how to plan my inspections based on results from projects like my own?
  - Based on my inspection results, what are the implications for the effort required to be spent on other non-optional activities, like system testing?

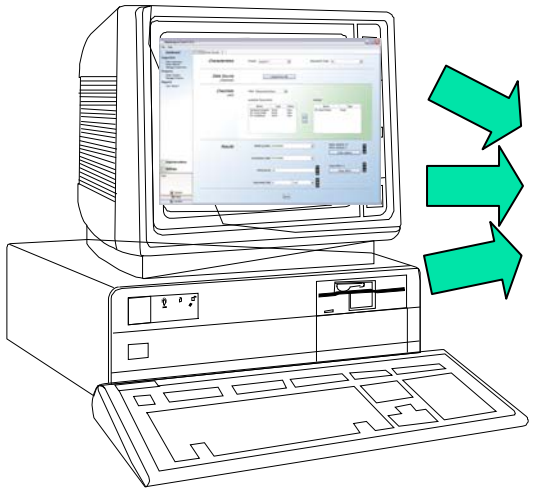


Our approach

Literature Recommendations

Historical Baseline Models

Current Model Formulation



Inputs from:
- GSFC
- GRC
- JPL
- JSC
- MSFC

More to come…

Outputs:
- Automated feedback
- What if Analysis
- Experience Bases
- Trends
- …

Users:
- Projects
- SEPG
- Inspection Planners
- Researchers

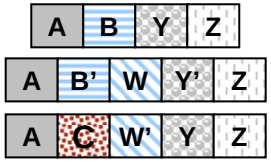
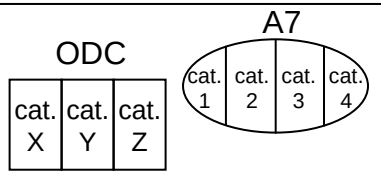
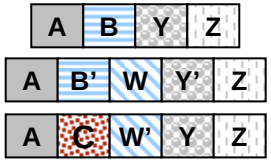
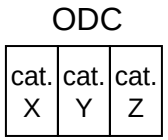
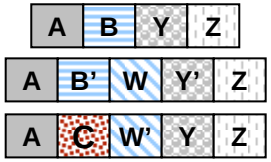
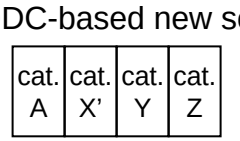
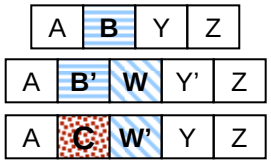
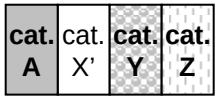
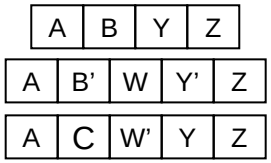
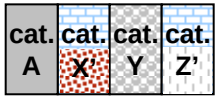
First year results

- Collected more than 2,529 inspection records in our database
  - Evaluated old classification schema
  - Developed new classification based on existing standards and the collected data
  - Mapped data into new classification schema
- Developed prototype tool to support planning and reporting
  - Incorporated latest analyses and models based on the data
  - Designed capabilities for accepting data from various forms (e.g., JPL forms) as well as various databases
  - Gained feedback on usability and possible enhancements
- Created central inspection experience base
  - Provides materials necessary for applying inspections in various contexts: e.g., defect type definitions, mapping to various taxonomies, checklists, forms, …

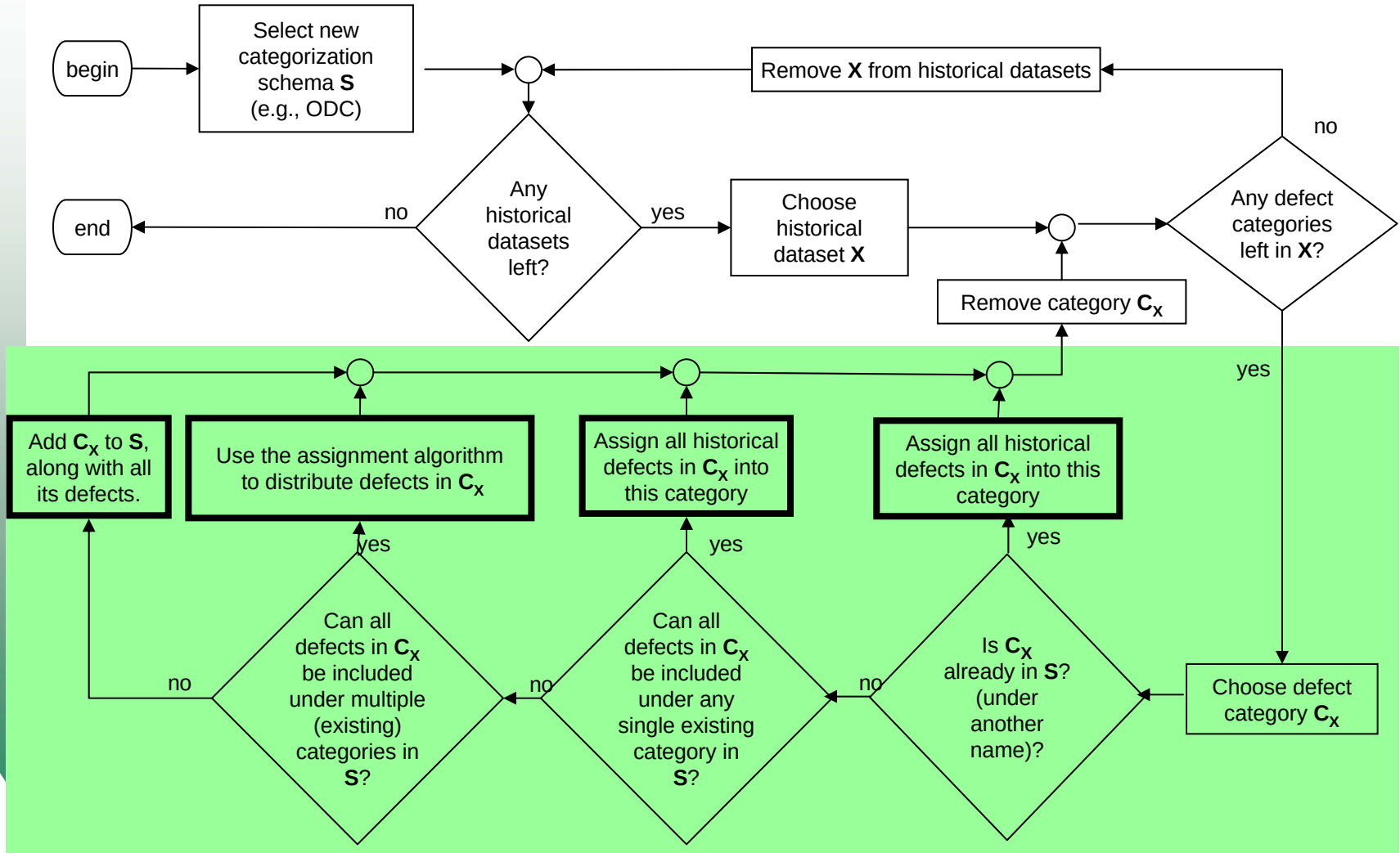
Unifying different defect classifications

- ***Motivation*: Valuable defect data has been collected over the years across many Centers and projects**
- ***Issue*: Different defect classifications used in historic and contemporary data sets, as well as across and within Centers**
- ***Action*: Define a unified defect classification schema along with a mapping to existing data sets**
- ***Benefits*:**
  - Leverages data required by NPR 7150.2 for analysis and feedback to teams
  - Enables monitoring and validation of existing guidelines
  - Unified classification schema is applicable to inspections and testing

Mapping the different data sets

historic data sets	actions	contemporary data
	Select candidate defect categorization scheme (e.g., ODC)	
	Analyze historical categories; (e.g., keep A & Z; combine Y&Y'; exclude C; partition all others)	
	Define initial new categorization schema (i.e., mix of historic and common categorization schema)	
	Map historical data to new categorization, for categories that exist in both.	
	Partition remaining historical data set categories; refine new schema if needed	
	Review new categorization and mapping	

Mapping algorithm



Updating existing inspection guidelines

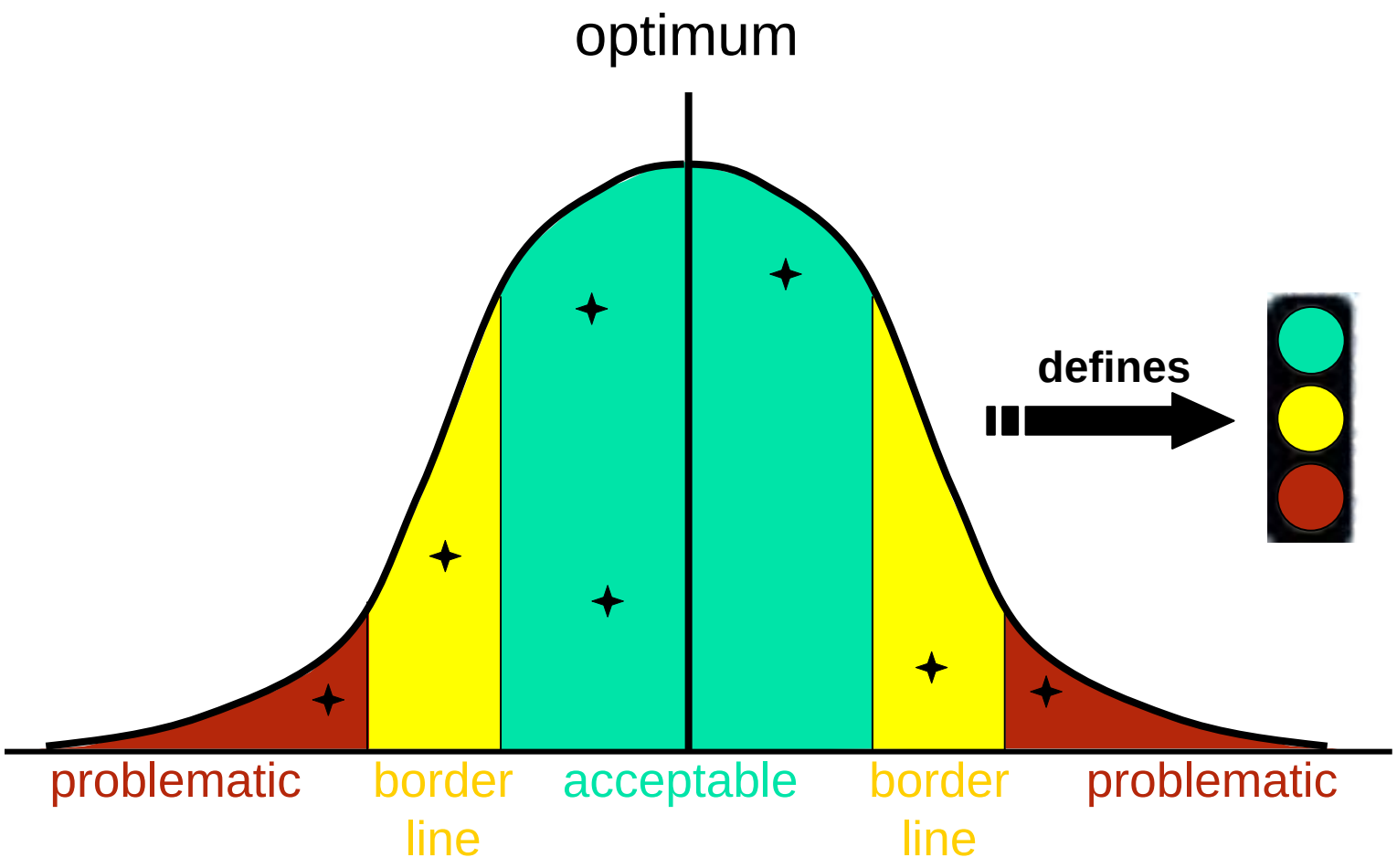
- ***Motivation*: NASA guidelines for effective inspections (e.g., 3 points of control) were formulated in early 1990's**

- ***Issue***: Development procedures (e.g., standards, languages, etc.) have changed over time;
  → New factors must be considered

- ***Action***:
  - Validate guidelines based on a wider set of recent data;
  - Refine the guidelines if needed (e.g., by adding more variables, tailoring to different domains, etc.)
  - Integrate them into an inspection support tool and training courses

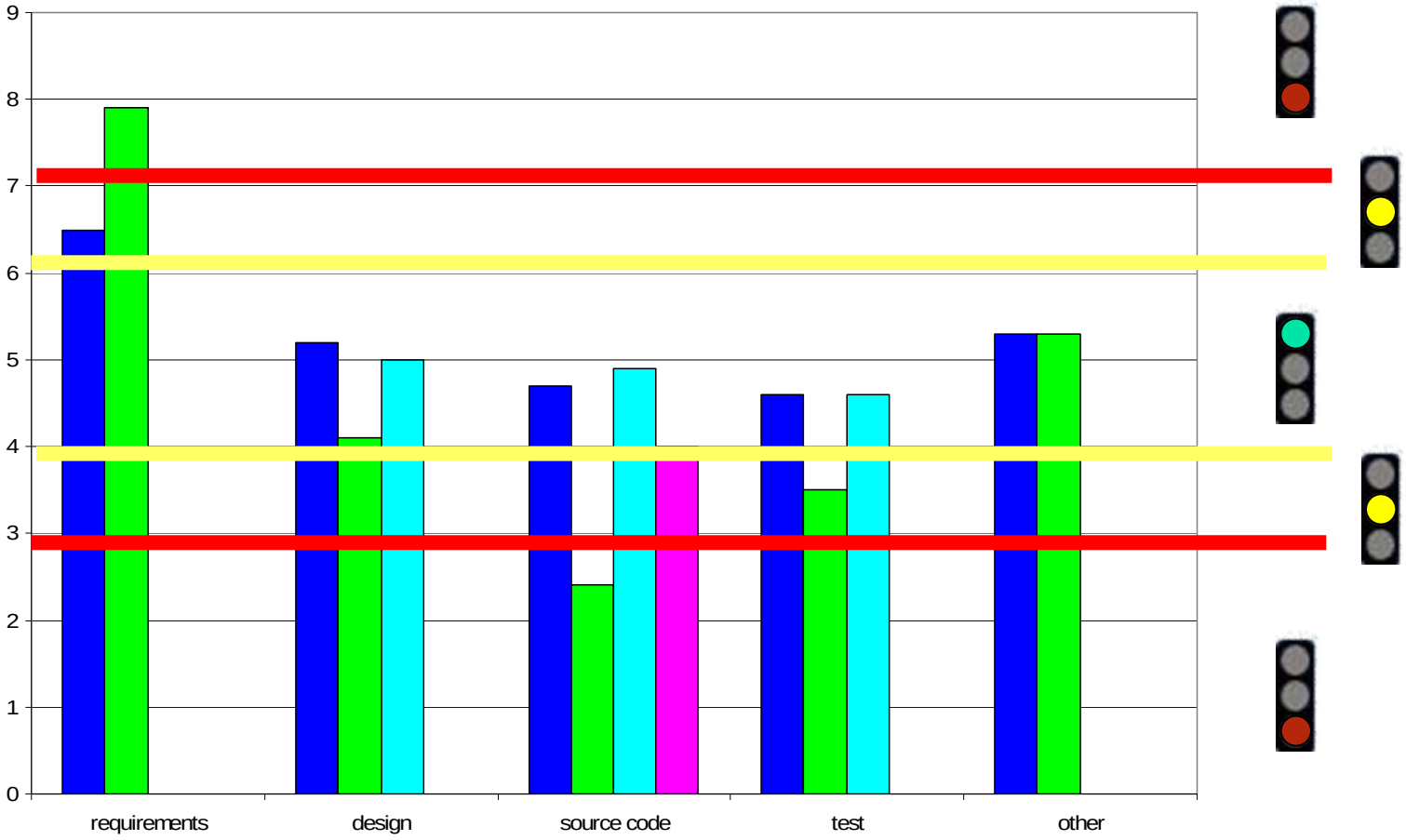
- ***Benefits*: Refined guidelines will increase effectiveness of inspections and provide better user guidance**

User guidance based on heuristics



Example: Comparison of team size

Target team size: optimal is 4 to 6; borderline is 3 or 7



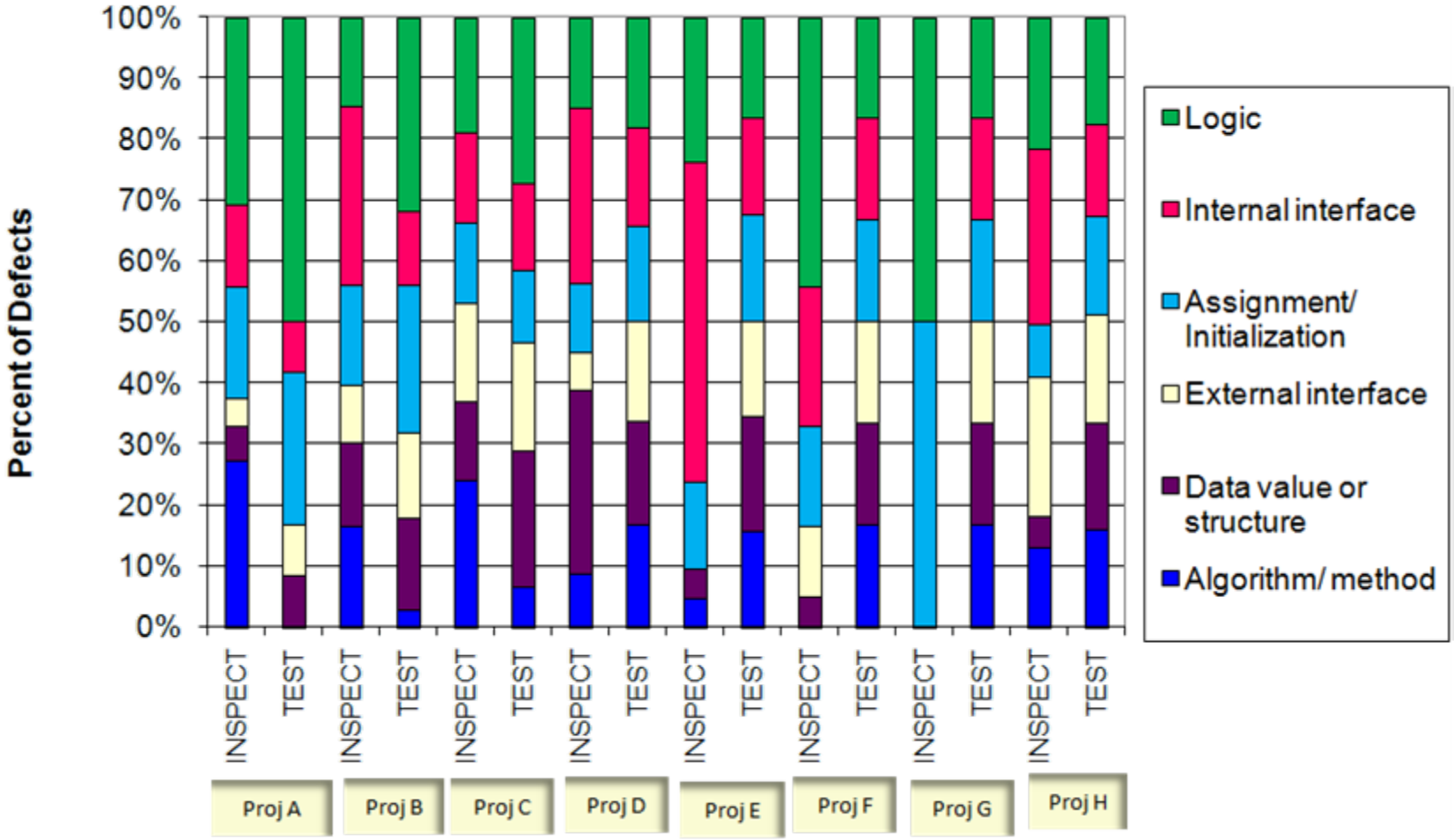
Comparing test and inspection data

- ***Motivation*:** Better knowledge of inspection's strengths & weaknesses could be used to better allocate resources among V&V activities.
- ***Issue***: Defects that slip through inspections aren't found until much later; different defect type descriptors mean they often are hard to compare.
- ***Action***: Compare test and inspection defect profiles (on the same projects or within the same domain)
- ***Benefits*:** Past knowledge about recurring defect types can be used to select the right overall strategy for optimal V&V planning

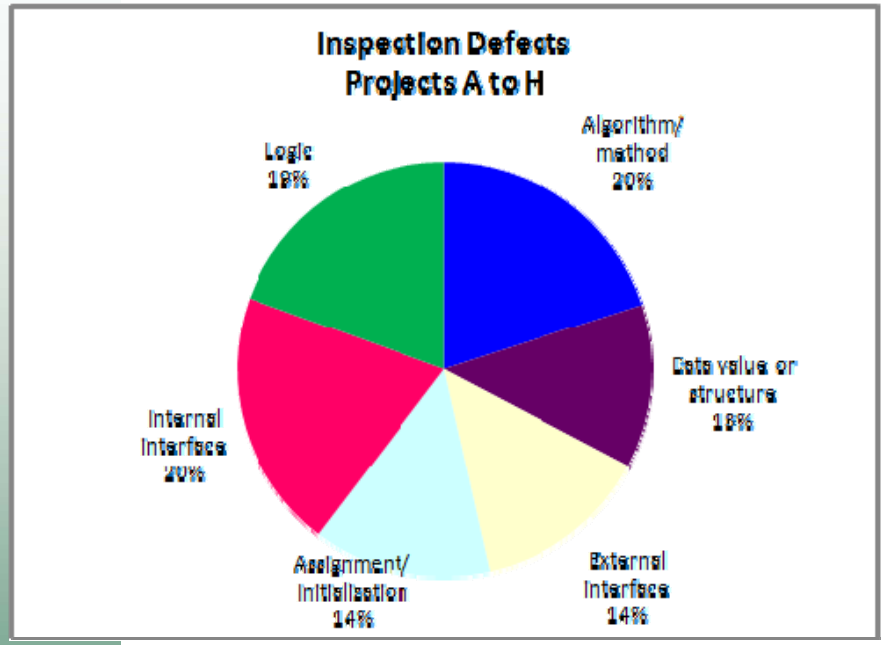
***Research Questions*:**

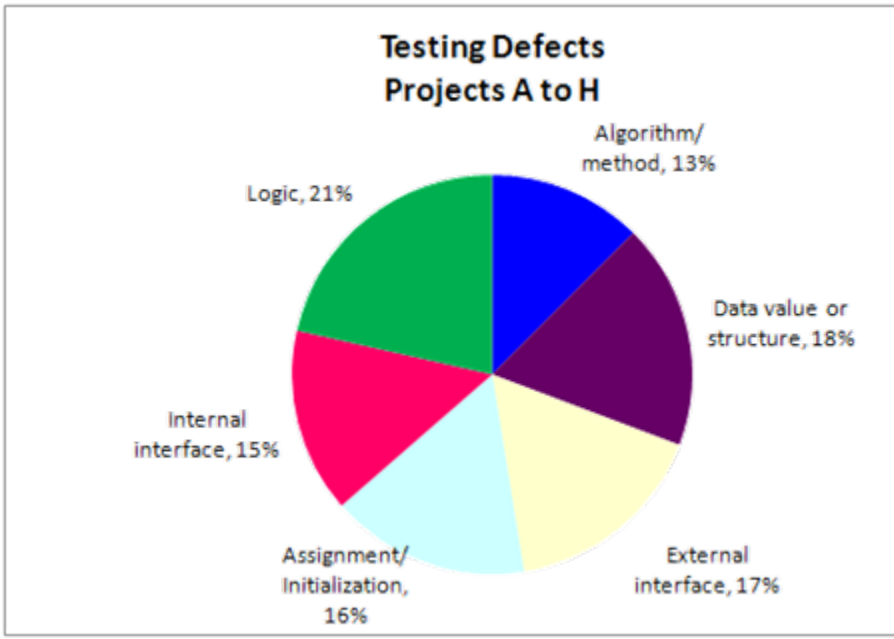
- What defects types are typically removed by inspections vs. testing?
- What project characteristics (size, language, software domain, new development/enhancements) influence the types of defects found?
- What percent of logic errors can be expected to be removed by inspections?
- Can test results be used for post-mortem analysis of inspection performance?

Overview: Inspections vs. testing



Initial results: Across projects



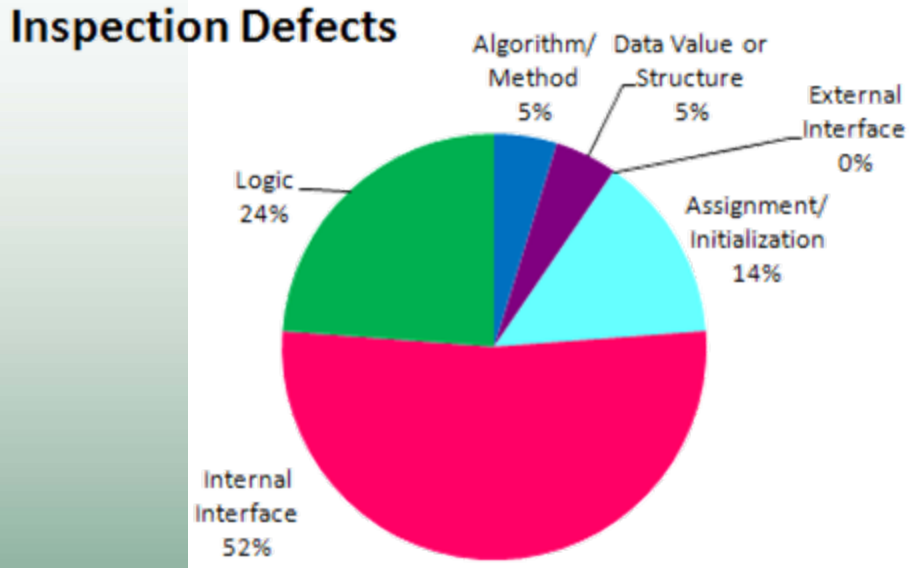


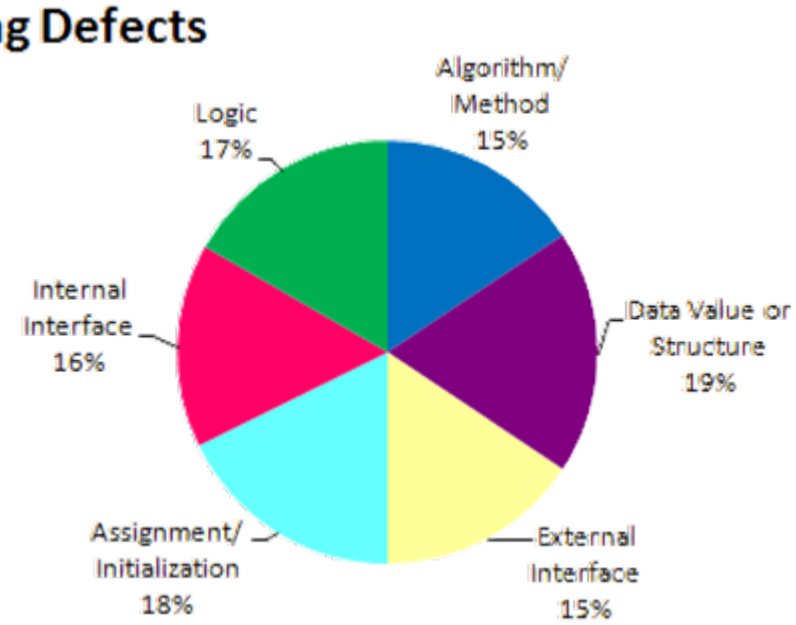
Research Question: What defect types are typically removed by inspections vs. testing? In this domain:

→ Overall the defect removal profile seems similar, but

→ Inspections found on average 64% of the total system defects

Initial results: Within a project





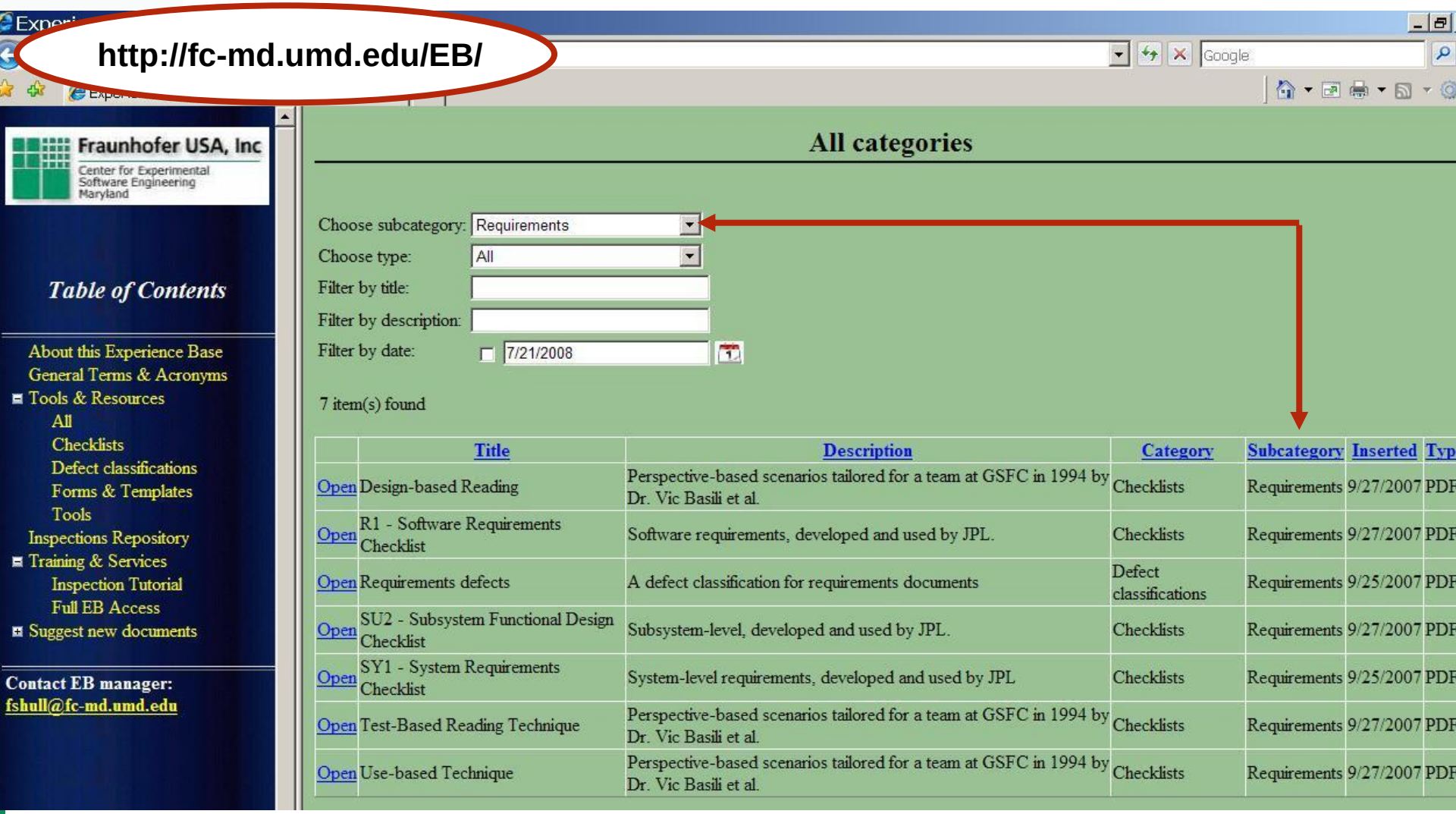
Research Question: What defect types are typically removed by inspections vs. testing? Specifically, for a maintenance project:
→ Many more internal interface defects were found by inspections

Improving tool support

- ***Motivation*: Data and resources from across NASA, that use different taxonomies, cannot easily be leveraged without centralized tool support.**
- ***Issue*: Need to do mappings and analysis without requiring extra steps from the user, and to seamlessly integrate the results.**
- ***Action*:**
  - Centralize existing materials and resources → Experience Base;
  - Integrate Experience Base and results data into a combined dashboard
- ***Benefits*: Integrating real-time feedback into normal engineering activities, for:**
  - The planning of inspections,
  - Collection of data,
  - Analysis and building of up-to-date baselines,
  - Feedback and improvement.

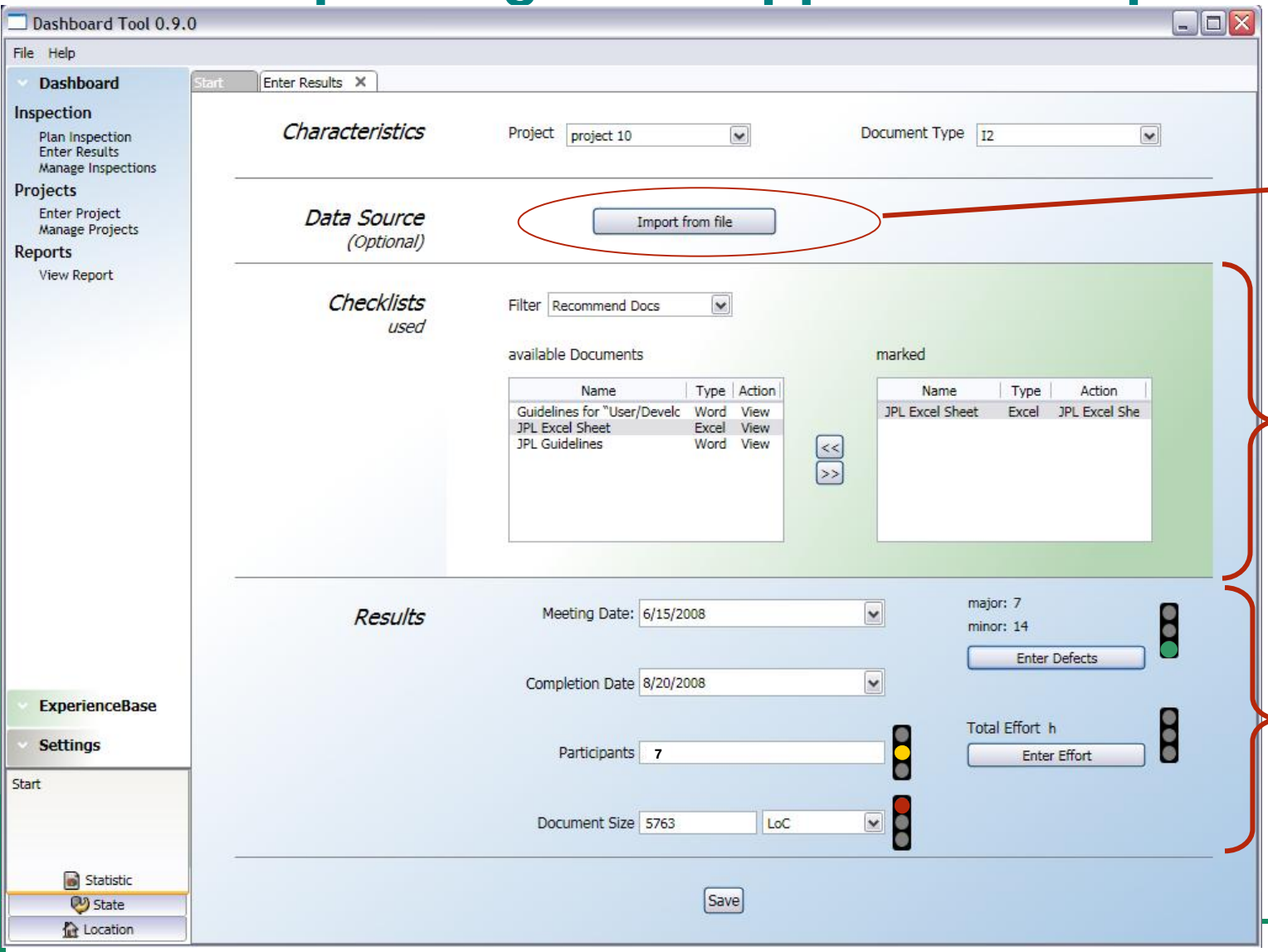
Providing an inspection experience base

http://fc-md.umd.edu/EB/



	Title	Description	Category	Subcategory	Inserted	Typ
Open	Design-based Reading	Perspective-based scenarios tailored for a team at GSFC in 1994 by Dr. Vic Basili et al.	Checklists	Requirements	9/27/2007	PDF
Open	R1 - Software Requirements Checklist	Software requirements, developed and used by JPL.	Checklists	Requirements	9/27/2007	PDF
Open	Requirements defects	A defect classification for requirements documents	Defect classifications	Requirements	9/25/2007	PDF
Open	SU2 - Subsystem Functional Design Checklist	Subsystem-level, developed and used by JPL.	Checklists	Requirements	9/27/2007	PDF
Open	SY1 - System Requirements Checklist	System-level requirements, developed and used by JPL	Checklists	Requirements	9/25/2007	PDF
Open	Test-Based Reading Technique	Perspective-based scenarios tailored for a team at GSFC in 1994 by Dr. Vic Basili et al.	Checklists	Requirements	9/27/2007	PDF
Open	Use-based Technique	Perspective-based scenarios tailored for a team at GSFC in 1994 by Dr. Vic Basili et al.	Checklists	Requirements	9/27/2007	PDF

Improving tool support for inspections



file import capability

built-in experience base access

reporting and evaluation capabilities

Future work

- **Refine the test and inspection data comparison**
  - Obtain additional data sets for testing and refining our preliminary conclusions
  - Integrate test results into inspection tool
- **Initial deployment of tool**
  - Obtain additional feedback on usability and future deployment
  - Pursue expansion of the Experience Base with testing-related materials → a centralized site for V&V resources
- **Integrating with other existing inspection data forms and tool support**
  - Especially eRoom-based tool available through Kevin Carmichael / GRC

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